

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 0 652 539 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
03.03.1999 Bulletin 1999/09

(51) Int Cl.⁶: **G07C 3/00**, G05B 19/418,
G06F 17/00

(21) Application number: **94116878.3**

(22) Date of filing: **26.10.1994**

(54) **A recording system for a production line**

Aufzeichnungssystem für eine Fertigungsstrasse

Système d'enregistrement pour une chaîne de production

(84) Designated Contracting States:
DE ES FR GB NL SE

(30) Priority: **05.11.1993 IT TO930838**

(43) Date of publication of application:
10.05.1995 Bulletin 1995/19

(73) Proprietor: **MAGNETI MARELLI S.p.A.**
20145 Milano (IT)

(72) Inventors:
• **Cipelletti, Marco**
I-27100 Pavia (IT)

• **Pasti, Orlando**
I-27100 Pavia (IT)

(74) Representative: **Quinterno, Giuseppe et al**
c/o JACOBACCI & PERANI S.p.A.
Corso Regio Parco, 27
10152 Torino (IT)

(56) References cited:
EP-A- 0 142 436 **GB-A- 2 239 325**
US-A- 4 027 246 **US-A- 5 056 028**

EP 0 652 539 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The present invention relates in general to data-collection systems associated with industrial production lines and, more specifically, to a data-collection system which ensures the traceability of the products of an industrial line.

[0002] The English term "traceability" means the ability to reconstruct the entire production process for each finished product output by the production line, that is, to identify all the components making up the finished product, and their origin, as well as all the manufacturing steps which the finished product has undergone, with their operating conditions.

[0003] The importance of the use of a system of this type in current industrial production lines is thus clear, particularly as far as the operations affecting the reliability and quality of the products are concerned.

[0004] According to the prior art, a system which performs these functions may be implemented, for example, by recording all the data relating to the production conditions of each product passing along the production line during production. The recording may take place in a database of known type, for example, a relational database. Whilst this solution has the merit of being essentially simple, practically it is not feasible.

[0005] In fact, the quantity of data to be recorded in order to control data relating to each individual product of a modern industrial production line is typically of the order of several millions of crude data, such as, for example, identification codes, per day. Such a quantity of data causes the cost of the hardware and software necessary for collection and subsequent retrieval to become prohibitive if compared with the cost of the production line itself.

[0006] Moreover, even supposing that such a mass of data were recorded, it would assume dimensions such as to be intractable, that is, it would become impossible to gain access to the data of interest within a reasonable time.

[0007] The object of the present invention is to provide a data-collection system which solves all the problems indicated above in a satisfactory manner.

[0008] According to the present invention, this object is achieved by virtue of a data-collection system having the characteristics indicated in the claims which follow the present description. A further subject of the invention is the related method.

[0009] Further advantages and characteristics of the present invention will become clear from the following detailed description given with the aid of the appended Figure 1, which is provided by way of non-limiting example and shows schematically, in block form, an automated industrial production line having a data-collection system according to the present invention.

[0010] The system according to the present invention has been developed by the Applicant specifically for use in association with a line for the automated production

of electronic control units. The principles upon which the invention is based are general, however, and may be applied to any industrial production line whether it be manual or partially or fully automated.

[0011] The system according to the invention is particularly useful in all production lines such as, for example, those in the automotive field, in which the quality and reliability of the product are of primary importance and it is important to be able to reconstruct the production life of the product completely, throughout the course of its life cycle, which may even be quite long, for example, 15 years, for a motor vehicle.

[0012] The purpose of the system according to the present invention, therefore, is to achieve a substantial reduction in the quantity of data stored so as to render the system economically feasible and the data retrievable in practice. The main characteristic of the system lies in the fact that it is possible to store only changes in the state of the production line and not elementary data, and that the data can be left independent until there is a precise requirement to associate them and/or organize them by means of a factor common to all the data collected.

[0013] Data can thus be associated with the certainty of matching the requirements for their use, even after several years. In the absence of a requirement to associate the data, they remain stored and unused and thus do not take up calculating resources but only minimal memory space. The factor common to all the data stored is the precise time at which the datum arose, the precise time of this event being derived automatically from the clock of the system.

[0014] The time is therefore the link between all the data which are collected by the system and which relate, for a finished product, both to the raw materials and to the process. It consequently suffices to reconstruct the time scale in order to find out which batches of raw materials were in use, what the process conditions were, and what were the states of the machines which contributed to the processing of a finished product during its construction in the production line.

[0015] Clearly, a system of this type may also be used to implement further functions which, typically, are the monitoring, that is, the checking, of the operating conditions of the production line and the statistical control of the processes.

[0016] A system of this type has many purposes; the main purposes are the following:

- to determine the relationships between the quality and reliability of the products by means of:
 - an instantaneous knowledge of the process parameters,
 - the quality of the materials used for the construction of the finished product,

- to trace the constituents of the product in terms of components and working conditions during the life cycle of the product (several years),
- to know, in real time, the loading of the machines of the production line and the stocks between machines of the production line,
- to know, in real time, all the economic data arising from the use of the production means,
- to help, in real time, to balance the lines in order to maximize the use of resources.

[0017] For a better understanding, an industrial production line provided with the system according to the invention will now be described in detail with reference to the drawing.

[0018] A typical industrial production line, for example, a line for the production of electronic control units, comprises a series of automatic and/or manual work stations S1, S2, S3, S4, S5, MAN. These stations are normally interconnected by means of a conveyor CONV. The electronic control units are constituted essentially by electronic boards, that is, printed circuits onto which all the electronic components constituting the control unit are soldered.

[0019] The printed circuit boards are therefore placed on the conveyor CONV at the input IN of the production line and thus pass through the various work stations S1, S2, S3, S4, S5, MAN. The work stations comprise, for example: automatic machines for mounting the components, machines for applying resins (used as adhesives), ovens for polymerizing the resins, flow-soldering machines, manual units MAN in which the components which cannot be mounted by automated machines are mounted. Moreover, the production line usually also comprises test equipment TEST (typically disposed at the end of the production line) which, for the purposes of the present invention, is comparable to the other work stations.

[0020] The line may also include one or more temporary stores M (sometimes also known as buffers) the purpose of which is to hold a stock of items so as to minimize the effect on the operation of the line of any machine stoppages or imbalances created by the fact that the same operation has different cycle times for different products. At the output OUT of the line, there is usually a packaging station IMB which concludes the line.

[0021] The process for the production of an electronic control unit thus starts with the input of a virgin printed circuit at the start of the production line. The printed circuit passes successively through the various work stations and undergoes all the manufacturing steps provided for by the production process until it emerges at the end of the production line in the form of a finished product, that is, a fully assembled and packaged electronic

control unit.

[0022] Several different types of control unit are normally produced on a modern production line and, for this reason, the printed circuits in the line may undergo different processes in the various work stations, may receive different components, or may possibly be processed in different stations or under different manufacturing conditions in the same station. Moreover, even two identical control units may differ because they receive, for example, components coming from different batches of material, or because there is a change in the operating conditions in the same manufacturing step or work station.

[0023] These characteristics are also common to most industrial automated production lines currently in use.

[0024] It is particularly advantageous to be able to reconstruct fully the entire history of the production process of each control unit output by the production line. To give only one example, if it is found that a certain batch of components is defective, it is very useful to be able to identify, and thus to trace, all the control units on which the components belonging to the defective batch have been mounted. As already stated, however, the cost of storing the full history of the production process for each electronic control unit is, without doubt, prohibitive and it is not feasible in practice.

[0025] The data-collection system according to the present invention, instead, operates differently since it does not store all the data relating to the production process for each individual product or control unit but stores only some data which are organized in a manner such as to permit subsequent complete reconstruction of the production process.

[0026] In the system, at the input IN of the production line, each printed circuit receives a label bearing a bar code (or the like, such as a dot-matrix code) which univocally identifies the printed circuit, and hence the electronic control unit, or, more generally, the finished product which will emerge from the output OUT of the production line. In the specific case of electronic control units, for example, when the printed circuit is assembled in the metal container of the control unit, its identification label is applied to the container. The identification in fact relates to the final product of the line and remains unchanged throughout the production process.

[0027] This label bearing the identification bar code is applied by means of an automatic labelling station LPRN situated at the beginning of the production line.

A bar-code reader LA is also associated with the conveyor CONV at the beginning of the production line and automatically reads the bar codes of the printed circuits entering the production line. The bar-code reader LA disposed at the input of the production line thus detects the input of the printed circuit to the line and communicates it to the central processor MSERV which controls the production line, together with a detection of the precise time, that is, the hour, minute and second and the

date, at which the printed circuit entered the production line.

[0028] The printed circuit then passes through the first work station S1 in which it undergoes a first manufacturing step. At the output of the first work station S1, there is another bar-code reader LA which is substantially identical to the first and which detects the output of the printed circuit from the first work station S1. Also the bar-code reader LA disposed at the output of the first station S1 communicates the detection of this event and the precise time associated therewith to the central processor MSERV.

[0029] This principle is common to the entire production line. As can be seen from the drawing, in fact, each work station S1, S2, S3, S4, S5, MAN, TEST has a pair of bar-code readers LA disposed at its input and at its output. For each work station, the input and the output of the printed circuit are thus detected, together with the precise input and output times.

[0030] Clearly, in order for these times to be consistent with one another, the clocks of the bar-code readers LA must be synchronized so that there is a single time or clock setting for the entire production line. This condition is ensured by the central processor MSERV which synchronizes the internal clocks of all the bar-code readers LA periodically by means of a communication network NET.

[0031] Typically, the communication network NET is already present in an industrial production line, its purpose being to connect the central processor MSERV to the automated work stations, which, typically, have control computers, or possibly to local processors LSERV which in turn control groups of automated work stations. The network NET in fact serves for the communication of all the data necessary for the normal control of the production line by the central processor MSERV and may be any network in common use, for example, an Ethernet network. Normal devices currently on the market may also be used for the bar-code readers LA and LM, provided that the time can be detected. The station LPRN for printing and applying the labels is also connected, by means of the network NET, to the central processor MSERV which is thus also informed of the input of the printed circuits to the line and can assign them univocal identification codes of the electronic control units which they will constitute.

[0032] To summarize the concepts explained hitherto, the central processor MSERV thus stores, for each printed circuit or product, the identification code and all the input and output times to and from each work station, that is, the times which correspond to the start and finish times of each manufacturing step. The input time to the first work station in practice coincides with the input time of the product to the production line and, in an equivalent manner, the output time from the last station in practice coincides with the time when the product is output from the production line. The data stored for each printed circuit, control unit, or finished product are thus limited to

the identification code and a series of times associated with the codes of the manufacturing steps carried out.

[0033] The codes and the times of input to and output from the various stations do not necessarily have to be detected by bar-code readers LA. In fact, as already stated, the various automatic work stations S1, S2, S3, S4, S5 are controlled by processors or microprocessors, and possibly also by local processors LSERV, which in turn are connected to the central processor MSERV by means of the communication network NET. Clearly, the various control processors of the work stations can be configured and/or programmed to detect some of the data acquired by the automatic bar-code readers LA.

[0034] Typically, these data are the times associated with the manufacturing steps carried out in the various stations. If this option is adopted, a single bar-code reader LA, possibly with an internal clock, associated with each automatic work station may even suffice.

[0035] Whatever method is used to detect the data, the principle of the invention, according to which each manufacturing step carried out on a product must give rise to the detection of at least one time associated with the step itself and of an identification code corresponding to the product which has undergone the processing, must in any case be complied with.

[0036] As can be seen, the data stored for each product are extremely concise and occupy a very limited space in the storage means HD used by the system. Optical-disc memories HD may advantageously be used for this purpose. These memories HD may be of the write-once type, better known by the abbreviation WORM (write once read many) since the data stored do not need to be modified subsequently. Moreover, this type of memory has the advantage of offering a large capacity at a very low cost and permits quite rapid access to the data.

[0037] In the stations in which there is a manual operation, such as, for example, the station MAN in the drawing, some of the data communicated to the central processor MSERV have to be acquired manually, for example, by means of a keyboard or by means of portable or mobile bar-code readers LM. The mobile bar-code readers LM also have internal clocks and, typically, have temporary (buffer) memories which temporarily store the data acquired. The mobile readers LM are periodically placed in suitable supports C, sometimes known in the jargon as inkwells, which, in practice, are communication devices. In fact, the inkwells C enable the mobile readers LM to download the data acquired, re-recording them in the central processor MSERV by means of the network NET. The inkwells C also enable the central processor MSERV periodically to synchronize the internal clocks of the mobile readers LM.

[0038] In the case of the manual operations MAN, the operators employed thus communicate the start and finish times of each manual manufacturing step, as well as the code of the product on which the manual step is carried out and the code of the manual step itself, to the

central processor MSERV by means of the mobile readers LM or by means of equivalent devices, for example, keyboards, and thus in exactly the same way as the automatic work stations.

[0039] This may not take place for the temporary stores M disposed in the line, since there is no manufacturing step corresponding thereto. They do not therefore need to have bar-code readers LA or LM or to be connected to the network NET unless this is necessary for other control requirements of the line. This usually also applies to the packaging station IMB.

[0040] The system according to the invention also stores a second set of data. This second set of data relates to the operating conditions and states of the work stations S1, S2, S3, S4, S5, MAN, TEST. The system in fact stores any change in the state of the operating conditions of any work station of the production line. In this case, the changes of state are also stored, together with the precise time, that is, the time and the date on which they occur.

[0041] A typical change in an operating condition is, for example, the starting of a new batch of components mounted by a work station, caused by the running-out of the previous batch of components. In this case, for example, the operator employed to replace the batch detects the code identifying the batch (which typically is printed on the container of the components as a bar code) by means of a mobile bar-code reader LM and it is thus communicated to the central processor MSERV, together with the time of the replacement. This takes place when the mobile reader LM is placed in its inkwell C exactly as described above.

[0042] Other changes of state in the operating conditions of the stations are changes in the temperatures of the ovens or changes of the operative parameters of the soldering machines. Also in this case, the general principle according to which, for each work station, each change of state, together with its time, is communicated by means of readers LM or other equivalent means to the central processor MSERV by means of the network NET is in any case followed. The network NET in fact also enables all these data to be communicated to the central processor MSERV and in the opposite direction, as already stated, to enable the central processor MSERV to synchronize the local clocks of the entire production line.

[0043] As already stated, this procedure naturally also applies to any testing stations TEST disposed on the production line. In these stations TEST, which may be either automatic or manual, the start and finish times of each test carried out on each product are thus acquired. Moreover, the result of each test, and possibly the code of any reject detected, is also acquired and then stored. If a rejected product is rectified and/or passes through any station of the line again, these manufacturing steps are also duly recorded in the manner explained hitherto. For various reasons, it may be convenient, for example, at the beginning of a working day or in any case at pe-

riodic intervals, to store the entire state of the production line. In fact, if the line does not operate with a continuous cycle, it is necessary to store all the operating conditions again upon restarting operations, since they may have changed. Moreover, as well as being a precautionary measure, this step is also useful in order to reconstruct the operating state of a given station without the need to go back over an unknown period of time to find out all the changes of state which define it.

[0044] This second set of data is also stored by the central processor MSERV in the discs HD constituting the archive of the system. Moreover, as can be seen, this second set of data is also quite small since the data are stored in a very concise manner. In order to make the storage and processing of the data quicker and more efficient, a relational database (available commercially) may be used for this purpose.

[0045] At this point, the system contains all the data necessary for the complete and detailed reconstruction of the production process of each individual finished product output from the production line. In fact, once a given finished product, the production process of which is to be reconstructed, has been identified, it suffices to communicate its code to a processor which has access to the memories HD and which, by consulting the file relating to the products, can easily recover all the start and finish times of each production step which the finished product in question has undergone. With the start and finish times of each production step available, the processor then consults the file relating to the changes of state of each work station to determine the precise working conditions existing at the moment when the product passed through that particular work station. This recovery method is slightly more complex because, since only the changes of state are recorded, it may be necessary to go back in time, possibly to the start of the working day, to be able precisely to reconstruct the operating conditions of the production step in question. The data can in this case, however, also be recovered safely and efficiently. Upon completion, the production history of the finished product is complete in every detail.

[0046] As already stated, the system has the considerable advantage that the data for the production line and for the finished products are stored independently and the two sets of data are correlated only when actually necessary, which eventuality typically occurs only for a fairly small percentage of the finished products output from the production line.

[0047] In a currently-preferred embodiment, the system may also be employed to use the elementary data collected in real time both for the optimized (just in time) control of the production line with the use of intelligent programs and to produce a summary of the elementary data for the management of the business, in cooperation with the information system of the business. In fact, the system can make the non-structured elementary data available to all the offices of the business with the facility for particular applications to be requested without losing

basic data.

[0048] The system can also cooperate, in real time, with some processors SPC which are sometimes present in the production line for the statistical control of the processes. The function of these processors SPC is to monitor the production line in real time for quality-control purposes. These processors SPC collect and process a series of data relating to quality, mainly the results of tests carried out in the test equipment TEST, and interact with the operatives and technicians employed on the production line. The function of the processors SPC is in fact to oversee the operating conditions of the various work stations, at the same time generating static analyses of the processes carried out therein and, when necessary, supplying the personnel employed with data and/or warnings, possibly in advance, if situations occur which require the intervention of the personnel.

[0049] Naturally, the processors SPC are connected to the central processor MSERV by means of the communication network NET and are also connected directly to the automatic work and testing stations with which they are associated. If the production line is provided with the system according to the invention, it is particularly advantageous for the processors SPC to have access to the data collected and processed by the system in real time so as to be able to perform their functions in an optimal manner.

[0050] Naturally, the principle of the invention remaining the same, the details of construction and forms of embodiment may be varied widely with respect to those described and illustrated, without thereby departing from the scope of the present invention which is defined in the appended claims.

Claims

1. A system for recording data relating to the production conditions of an article produced on a production line comprising a plurality of work stations (S1, S2, S3, S4, S5, MAN, TEST), characterized in that it comprises:
 - central processing means (MSERV),
 - memory means (HD) associated with the central processing means (MSERV),
 - communication means (NET) connecting the work stations (S1, S2, S3, S4, S5, MAN, TEST) and the central processing means (MSERV) to one another,
 - means (LPRN) for associating with each article a mark bearing an identification code which can be detected by instruments at the input (IN) of the line,
 - means (LA) for detecting and communicating to the central processing means (MSERV), when the article is input to and/or output from some of the stations of the line, the code associated with the article, a datum indicative of the manufacturing step carried out in the station, and a datum indicative of the time at which the code is detected,
 - means (LM) for detecting and communicating to the central processing means (MSERV), for at least some stations of the line, changes of state in the operating conditions of the station and a datum indicative of the time at which the change of state or operating condition of the station occurred,
- the central processing means (MSERV) being configured to store the codes, the changes of state, and the data in the memory means (HD).
2. A system according to Claim 1, characterized in that the means for associating a mark with each article comprise a station (LPRN) for printing a label bearing the identification code and for applying the label to the article.
 3. A system according to Claim 1 or Claim 2, characterized in that the identification code is printed on the label in the form of a bar code.
 4. A system according to any one of Claims 1 to 3, characterized in that the identification code is different for each article passing along the line.
 5. A system according to Claim 3 or Claim 4, characterized in that the means (LA) for detecting the code are associated with all the work stations (S1, S2, S3, S4, S5, MAN, TEST) of the line.
 6. A system according to Claim 5, characterized in that the datum indicative of the time at which the code is detected comprises a datum indicative of the date and a datum indicative of the time at which the detection takes place.
 7. A system according to Claim 5 or Claim 6, characterized in that the datum indicative of the manufacturing step carried out comprises a datum indicative of the work station in which the manufacturing step was carried out.
 8. A system according to Claim 7, characterized in that the datum indicative of the manufacturing step carried out comprises a datum indicative of the specific operations carried out in the manufacturing step.
 9. A system according to Claim 7 or Claim 8, in which

the work stations (S1, S2, S3, S4, S5, MAN, TEST) comprise testing stations (TEST), characterized in that the datum indicative of the manufacturing step carried out comprises a datum indicative of the result of the manufacturing step.

10. A system according to Claim 9, characterized in that the means (LM) for detecting and recording the changes of state are associated with all the work stations (S1, S2, S3, S4, S5, MAN, TEST) of the line.

11. A system according to Claim 10, characterized in that the datum indicative of the time at which the changes of state occur comprises a datum indicative of the date and a datum indicative of the time at which the changes of state occur.

12. A system according to Claim 10 or Claim 11, characterized in that the means (LM) for detecting and recording the changes of state are configured to detect and record changes of state selected from the group constituted by:

- changes in the batch of components and/or materials used in the work stations,
- changes in the control programs of the work stations,
- changes in the operating parameters of the work stations,
- changes in the test programs of the work stations,
- changes in the tools used in the work stations,
- changes in the environmental conditions relating to the work stations,
- changes in the personnel employed in the work stations.

13. A system according to Claim 12, characterized in that the means (LM) for detecting and recording the changes of state are configured to detect and record all the changes of state.

14. A system according to any one of Claims 1 to 13, characterized in that the means for detecting the codes comprise automatic bar-code readers (LA).

15. A system according to any one of Claims 1 to 14, characterized in that the means for detecting the changes of state comprise bar-code readers (LM).

16. A system according to any one of Claims 1 to 15,

characterized in that the central processing means (MSERV) are adapted and configured to synchronize periodically all the time-measurement devices included in the line.

17. A method of recording data relating to the production conditions of an article produced on a production line comprising a plurality of work stations (S1, S2, S3, S4, S5, MAN, TEST), characterized in that it comprises the following steps:

- associating with each article a mark bearing an identification code which can be detected instrumentally at the input (IN) of the line,
- detecting and recording on memory means (HD), when the article is input to and/or output from some of the stations of the line, the code associated with the article, a datum indicative of the manufacturing step carried out in the station, and a datum indicative of the time at which the code is detected,
- detecting and recording on the memory means (HD), for at least some stations of the line, changes of state in the operating conditions of the station and a datum indicative of the time at which the change of state or operating condition of the station occurred.

18. A method according to Claim 17, characterized in that the step of associating a mark with each article comprises the steps of producing a label bearing the identification code and of applying the label to the article.

19. A method according to claim 17 or Claim 18, characterized in that the code is printed on the label in the form of a bar code.

20. A method according to any one of Claims 17 to 19, characterized in that the identification code is different for each article passing along the line.

21. A method according to Claim 19 or Claim 20, characterized in that the step of detecting and recording the code takes place for all the work stations of the line.

22. A method according to Claim 21, characterized in that the datum indicative of the time at which the code is detected comprises a datum indicative of the date and a datum indicative of the time at which the detection takes place.

23. A method according to Claim 21 or Claim 22, characterized in that the datum indicative of the manufacturing step carried out comprises a datum indic-

ative of the work station in which the manufacturing step was carried out.

24. A method according to Claim 23, characterized in that the datum indicative of the manufacturing step carried out comprises a datum indicative of the specific operations carried out in the manufacturing step. 5
25. A method according to Claim 23 or Claim 24, in which the manufacturing steps comprise testing steps, characterized in that the datum indicative of the manufacturing step carried out comprises a datum indicative of the result of the manufacturing step. 10
26. A method according to Claim 25, characterized in that the step of detecting and recording the changes of state takes place for all the work stations of the line. 15
27. A method according to Claim 26, characterized in that the datum indicative of the time at which the changes of state occur comprises a datum indicative of the date and a datum indicative of time at which the changes of state occurred. 20
28. A method according to Claim 26 or Claim 27, characterized in that the step of detecting and recording the changes of state takes place for changes of state selected from the group constituted by: 25
- changes in the batch of components and/or materials used in the work stations, 30
 - changes in the control programs of the work stations, 35
 - changes in the operating parameters of the work stations, 40
 - changes in the test programs of the work stations, 45
 - changes in the tools used in the work stations, 50
 - changes in the environmental conditions relating to the work stations, 55
 - changes in the personnel employed in the work stations.
29. A method according to Claim 28, characterized in that the step of detecting and recording the changes of state takes place for all the changes of state.
30. A method according to any one of Claims 17 to 29, characterized in that the codes are detected by

means of automatic bar-code readers (LA).

31. A method according to any one of Claims 17 to 30, characterized in that some of the changes of state are detected by the reading of bar codes.
32. A method according to any one of Claims 17 to 31, in which the line comprises a processing and communication system (MSERV, LSERV, NET), characterized in that it comprises the step of communicating the detection of the codes and of the changes of state by means of the communication system (NET).
33. A method according to any one of Claims 17 to 32, characterized in that it comprises the step of periodically synchronizing all the time-measurement devices included in the line.

Patentansprüche

1. System für die Aufzeichnung von Daten, die sich auf die Fertigungsbedingungen eines Gegenstands beziehen, der in einer Fertigungsstraße erzeugt wird, die eine Vielzahl von Arbeitsstationen (S1, S2, S3, S4, S5, MAN, TEST) enthält, dadurch gekennzeichnet, dass das System enthält:
 - eine zentrale Prozessorstufe (MSERV),
 - eine Speicherstufe (HD), die der zentralen Prozessorstufe (MSERV) zugeordnet ist,
 - eine Übertragungseinrichtung (NET), über die die Arbeitsstationen (S1, S2, S3, S4, S5, MAN, TEST) und die zentrale Prozessorstufe (MSERV) miteinander verbunden sind,
 - eine Einrichtung (LPRN), um jedem Gegenstand eine Markierung zuzuordnen, die einen Erkennungscode trägt, der von Geräten am Eingang (IN) der Straße abgetastet werden kann,
 - Einrichtungen (LA), um den Kode, der dem Gegenstand zugeordnet wurde, einen Datenwert, der den in der Station ausgeführten Fertigungsschritt angibt, sowie einen Datenwert, der die Zeit angibt, zu der der Kode abgetastet wurde, abzutasten und zur zentralen Prozessorstufe (MSERV) zu übertragen, wenn der Gegenstand in eine Station der Fertigungsstraße eintritt und/oder aus dieser austritt,
 - Einrichtungen (LM), um für zumindest einige Stationen der Straße Zustandsänderungen in den Betriebsbedingungen der Station sowie ei-

nen Datenwert, der die Zeit angibt, zu der die Änderung des Zustands oder der Betriebsbedingung der Station aufgetreten ist, abzutasten und zur zentralen Prozessorstufe (MSERV) zu übertragen,

wobei die zentrale Prozessorstufe (MSERV) so aufgebaut ist, um die Codes, die Zustandsänderungen sowie die Daten in der Speicherstufe (HD) zu speichern.

2. System gemäß Anspruch 1, dadurch gekennzeichnet, dass die Einrichtung, um jedem Gegenstand eine Markierung zuzuordnen, eine Station (LPRN) enthält, um ein Schild zu drucken, das den Erkennungskode trägt, und das Schild auf dem Gegenstand anzubringen.
3. System gemäß Anspruch 1 oder 2, dadurch gekennzeichnet, dass der Erkennungskode auf das Schild in Form eines Streifenkodes aufgedruckt wird.
4. System gemäß irgendeinem der Ansprüche 1 bis 3, dadurch gekennzeichnet, dass der Erkennungskode für jeden Gegenstand verschieden ist, der die Straße durchläuft.
5. System gemäß Anspruch 3 oder 4, dadurch gekennzeichnet, dass die Einrichtungen (LA) für die Abtastung des Codes allen Arbeitsstationen (S1, S2, S3, S4, S5, MAN, TEST) der Straße zugeordnet sind.
6. System gemäß Anspruch 5, dadurch gekennzeichnet, dass der Datenwert, der die Zeit angibt, zu der der Kode abgetastet wird, einen Datenwert, der das Datum angibt, sowie einen Datenwert enthält, der die Zeit angibt, zu der die Abtastung erfolgt.
7. System gemäß Anspruch 5 oder 6, dadurch gekennzeichnet, dass der Datenwert, der den ausgeführten Fertigungsschritt angibt, einen Datenwert enthält, der die Arbeitsstation angibt, in der der Fertigungsschritt ausgeführt wurde.
8. System gemäß Anspruch 7, dadurch gekennzeichnet, dass der Datenwert, der den ausgeführten Fertigungsschritt angibt, einen Datenwert enthält, der die bestimmten Vorgänge angibt, die beim Fertigungsschritt ausgeführt wurden.
9. System gemäß Anspruch 7 oder 8, wobei die Arbeitsstationen (S1, S2, S3, S4, S5, MAN, TEST) Prüfstationen (TEST) enthalten, dadurch gekennzeichnet, dass der Datenwert, der den ausgeführten Fertigungsschritt angibt, einen Datenwert enthält, der das Ergebnis des Fertigungsschritts an-

gibt.

10. System gemäß Anspruch 9, dadurch gekennzeichnet, dass die Einrichtungen (LM), um Zustandsänderungen abzutasten und aufzuzeichnen, allen Arbeitsstationen (S1, S2, S3, S4, S5, MAN, TEST) der Straße zugeordnet sind.
11. System gemäß Anspruch 10, dadurch gekennzeichnet, dass der Datenwert, der die Zeit angibt, zu der die Zustandsänderungen auftreten, einen Datenwert, der das Datum angibt, sowie einen Datenwert enthält, der die Zeit angibt, zu der die Zustandsänderungen auftreten.
12. System gemäß Anspruch 10 oder 11, dadurch gekennzeichnet, dass die Einrichtungen (LM), um die Zustandsänderungen abzutasten und aufzuzeichnen, so aufgebaut sind, um Zustandsänderungen abzutasten und aufzuzeichnen, die aus einer Gruppe ausgewählt werden, die gebildet wird aus:
 - Änderungen in der Charge von Bauelementen und/oder Materialien, die in den Arbeitsstationen verwendet werden,
 - Änderungen in den Steuerprogrammen der Arbeitsstationen,
 - Änderungen in den Betriebsparametern der Arbeitsstationen,
 - Änderungen in den Prüfprogrammen der Arbeitsstationen,
 - Änderungen in den Werkzeugen, die in den Arbeitsstationen verwendet werden,
 - Änderungen der Umgebungsbedingungen, die die Arbeitsstationen betreffen,
 - Änderungen im Personal, das bei den Arbeitsstationen eingesetzt ist.
13. System gemäß Anspruch 12, dadurch gekennzeichnet, dass die Einrichtungen (LM), um Zustandsänderungen abzutasten und aufzuzeichnen, so aufgebaut sind, um alle Zustandsänderungen abzutasten und aufzuzeichnen.
14. System gemäß irgendeinem der Ansprüche 1 bis 13, dadurch gekennzeichnet, dass die Einrichtungen zum Abtasten der Codes automatische Streifenkode-Leser (LA) enthalten.
15. System gemäß irgendeinem der Ansprüche 1 bis 14, dadurch gekennzeichnet, dass die Einrichtungen zum Abtasten der Zustandsänderungen Strei-

fenkode-Leser (LM) enthalten.

16. System gemäß irgendeinem der Ansprüche 1 bis 15, dadurch gekennzeichnet, dass die zentrale Prozessorstufe (MSERV) so eingerichtet und aufgebaut ist, um alle Zeitmesseinrichtungen periodisch zu synchronisieren, die in der Straße enthalten sind.
17. Verfahren für die Aufzeichnung von Daten, die sich auf die Fertigungsbedingungen eines Gegenstands beziehen, der in einer Fertigungsstraße erzeugt wird, die eine Vielzahl von Arbeitsstationen (S1, S2, S3, S4, S5, MAN, TEST) enthält, dadurch gekennzeichnet, dass das Verfahren folgende Schritte aufweist:
- Zuordnen zu jedem Gegenstand von einer Markierung, die einen Erkennungskode trägt, der am Eingang (IN) der Straße mit einem Gerät abgetastet werden kann,
 - Abtasten und Aufzeichnen des Kodes, der jedem Gegenstand zugeordnet ist, eines Datenwerts, der jenen Fertigungsschritt angibt, der in der Station ausgeführt wird, sowie eines Datenwerts, der die Zeit angibt, zu der der Kode abgetastet wird, in einer Speicherstufe (HD), wenn der Gegenstand in einige Stationen der Straße eintritt und/oder aus diesen austritt,
 - Abtasten und Aufzeichnen von Zustandsänderungen in den Betriebsbedingungen der Station sowie eines Datenwerts, der die Zeit angibt, zu der die Änderung des Zustands oder der Betriebsbedingung der Station aufgetreten ist, in der Speicherstufe (HD) für zumindest einige der Stationen in der Straße.
18. Verfahren gemäß Anspruch 17, dadurch gekennzeichnet, dass der Schritt, um jedem Gegenstand eine Markierung zuzuordnen, Schritte enthält, um ein Schild zu erzeugen, das den Erkennungskode trägt, und das Schild auf dem Gegenstand anzubringen.
19. Verfahren gemäß Anspruch 17 oder 18, dadurch gekennzeichnet, dass der Kode auf das Schild in Form eines Streifenkodes aufgedruckt wird.
20. Verfahren gemäß irgendeinem der Ansprüche 17 bis 19, dadurch gekennzeichnet, dass der Erkennungskode für jeden Gegenstand verschieden ist, der die Straße durchläuft.
21. Verfahren gemäß Anspruch 19 oder 20, dadurch gekennzeichnet, dass der Schritt für die Abtastung und Aufzeichnung des Kodes in allen Arbeitsstationen

der Straße ausgeführt wird.

22. Verfahren gemäß Anspruch 21, dadurch gekennzeichnet, dass der Datenwert, der die Zeit angibt, zu der der Kode abgetastet wird, einen Datenwert, der das Datum angibt, sowie einen Datenwert enthält, der die Zeit angibt, zu der die Abtastung erfolgt.
23. Verfahren gemäß Anspruch 21 oder 22, dadurch gekennzeichnet, dass der Datenwert, der den ausgeführten Fertigungsschritt angibt, einen Datenwert enthält, der die Arbeitsstation angibt, in der der Fertigungsschritt ausgeführt wurde.
24. Verfahren gemäß Anspruch 23, dadurch gekennzeichnet, dass der Datenwert, der den ausgeführten Fertigungsschritt angibt, einen Datenwert enthält, der die bestimmten Vorgänge angibt, die beim Fertigungsschritt ausgeführt werden.
25. Verfahren gemäß Anspruch 23 oder 24, wobei die Fertigungsschritte Prüfschritte enthalten, dadurch gekennzeichnet, dass der Datenwert, der den ausgeführten Fertigungsschritt angibt, einen Datenwert enthält, der das Ergebnis des Fertigungsschritts angibt.
26. Verfahren gemäß Anspruch 25, dadurch gekennzeichnet, dass der Schritt, um Zustandsänderungen abzutasten und aufzuzeichnen, in allen Arbeitsstationen der Straße ausgeführt wird.
27. Verfahren gemäß Anspruch 26, dadurch gekennzeichnet, dass der Datenwert, der die Zeit angibt, zu der die Zustandsänderungen auftreten, einen Datenwert, der das Datum angibt, sowie einen Datenwert enthält, der die Zeit angibt, zu der die Zustandsänderungen aufgetreten sind.
28. Verfahren gemäß Anspruch 26 oder 27, dadurch gekennzeichnet, dass der Schritt, um die Zustandsänderungen abzutasten und aufzuzeichnen, für Zustandsänderungen erfolgt, die aus einer Gruppe ausgewählt werden, die gebildet wird aus:
- Änderungen in der Charge von Bauelementen und/oder Materialien, die in den Arbeitsstationen verwendet werden,
 - Änderungen in den Steuerprogrammen der Arbeitsstationen,
 - Änderungen in den Betriebsparametern der Arbeitsstationen,
 - Änderungen in den Prüfprogrammen der Arbeitsstationen,

- Änderungen in den Werkzeugen, die in den Arbeitsstationen verwendet werden,
 - Änderungen der Umgebungsbedingungen, die die Arbeitsstationen betreffen, 5
 - Änderungen im Personal, das bei den Arbeitsstationen eingesetzt ist.
29. Verfahren gemäß Anspruch 28, dadurch gekennzeichnet, dass der Schritt, um Zustandsänderungen abzutasten und aufzuzeichnen, für alle Zustandsänderungen ausgeführt wird. 10
30. Verfahren gemäß irgendeinem der Ansprüche 17 bis 29, dadurch gekennzeichnet, dass die Codes mit Hilfe von automatischen Streifenkode-Lesern (LA) abgetastet werden. 15
31. Verfahren gemäß irgendeinem der Ansprüche 17 bis 30, dadurch gekennzeichnet, dass einige Zustandsänderungen durch das Lesen von Streifenkodes abgetastet werden. 20
32. Verfahren gemäß irgendeinem der Ansprüche 17 bis 31, wobei die Straße ein Verarbeitungs- und Übertragungssystem (MSERV, LSERV, NET) enthält, dadurch gekennzeichnet, dass das Verfahren einen Schritt enthält, um das Abtasten der Codes und der Zustandsänderungen mit Hilfe des Übertragungssystems (NET) zu übertragen. 25
33. Verfahren gemäß irgendeinem der Ansprüche 17 bis 32, dadurch gekennzeichnet, dass das Verfahren einen Schritt enthält, um alle Zeitmesseinrichtungen periodisch zu synchronisieren, die in der Straße enthalten sind. 30
- Revendications** 40
1. Système pour enregistrer des données concernant les conditions de production d'un article produit sur une chaîne de production comprenant une pluralité de postes de travail (S1, S2, S3, S4, S5, MAN, TEST), caractérisé en ce qu'il comprend: 45
- des moyens centraux de traitement (MSERV),
 - des moyens de mémoire (HD) associés aux moyens centraux de traitement (MSERV),
 - des moyens de communication (NET) reliant les postes de travail (S1, S2, S3, S4, S5, MAN, TEST) et les moyens centraux de traitement (MSERV) entre eux, 50
 - des moyens (LPRN) pour associer à chaque article une marque portant un code d'identification qui peut être détecté par des instruments à l'entrée (IN) de la chaîne, 55
- des moyens (LA) pour détecter et communiquer aux moyens centraux de traitement (MSERV), quand l'article est entré dans et/ou sorti d'un des postes de la chaîne, le code associé à l'article, une donnée indiquant l'étape de fabrication effectuée à ce poste, et une donnée indiquant l'heure à laquelle le code est détecté,
 - des moyens (LM) pour détecter et communiquer aux moyens centraux de traitement (MSERV), au moins pour certains postes de la chaîne, des changements d'état au niveau des conditions de fonctionnement du poste et une donnée indiquant l'heure à laquelle le changement d'état ou de condition de fonctionnement du poste s'est produit, les moyens centraux de traitement (MSERV) étant configurés pour stocker les codes, les changements d'état, et les données dans les moyens de mémoire (HD).
2. Système selon la revendication 1, caractérisé en ce que les moyens pour associer une marque à chaque article comprennent un poste (LPRN) pour imprimer une étiquette portant le code d'identification et pour appliquer l'étiquette sur l'article.
3. Système selon la revendication 1 ou la revendication 2, caractérisé en ce que le code d'identification est imprimé sur l'étiquette sous la forme d'un code à barres.
4. Système selon l'une quelconque des revendications 1 à 3, caractérisé en ce que le code d'identification est différent pour chaque article passant sur la chaîne.
5. Système selon la revendication 3 ou la revendication 4, caractérisé en ce que les moyens (LA) pour détecter le code sont associés à tous les postes de travail (S1, S2, S3, S4, S5, MAN, TEST) de la chaîne.
6. Système selon la revendication 5, caractérisé en ce que la donnée indiquant le moment où le code est détecté comprend une donnée indiquant la date et une donnée indiquant l'heure à laquelle la détection a lieu.
7. Système selon la revendication 5 ou la revendication 6, caractérisé en ce que la donnée indiquant l'étape de fabrication effectuée comprend une donnée indiquant le poste de travail où l'étape de fabrication a été effectuée.
8. Système selon la revendication 7, caractérisé en ce que la donnée indiquant l'étape de fabrication effectuée comprend une donnée indiquant les opéra-

- tions spécifiques effectuées à l'étape de fabrication.
9. Système selon la revendication 7 ou la revendication 8, dans lequel les postes de travail (S1, S2, S3, S4, S5, MAN, TEST) comprennent des postes de test (TEST), caractérisé en ce que la donnée indiquant l'étape de fabrication effectuée comprend une donnée indiquant le résultat de l'étape de fabrication. 5
 10. Système selon la revendication 9, caractérisé en ce que les moyens (LM) pour détecter et enregistrer les changements d'état sont associés à tous les postes de travail (S1, S2, S3, S4, S5, MAN, TEST) de la chaîne. 10
 11. Système selon la revendication 10, caractérisé en ce que la donnée indiquant le moment où les changements d'état se produisent comprend une donnée indiquant la date et une donnée indiquant l'heure à laquelle les changements d'état se produisent. 15
 12. Système selon la revendication 10 ou la revendication 11, caractérisé en ce que les moyens (LM) pour détecter et enregistrer les changements d'état sont configurés pour détecter et enregistrer les changements d'état sélectionnés du groupe constitué par: 20
 - les changements dans le lot de composants et/ou de matériaux utilisés sur les postes de travail, 25
 - les changements dans les programmes de commande des postes de travail, 30
 - les changements dans les paramètres de fonctionnement des postes de travail, 35
 - les changements dans les programmes de test des postes de travail,
 - les changements dans les outils utilisés sur les postes de travail,
 - les changements dans les conditions d'environnement concernant les postes de travail, 40
 - les changements dans le personnel employé aux postes de travail.
 13. Système selon la revendication 12, caractérisé en ce que les moyens (LM) pour détecter et enregistrer les changements d'état sont configurés pour détecter et enregistrer tous les changements d'état. 45
 14. Système selon l'une quelconque des revendications 1 à 13, caractérisé en ce que les moyens pour détecter les codes comprennent des lecteurs de code à barres automatiques (LA). 50
 15. Système selon l'une quelconque des revendications 1 à 14, caractérisé en ce que les moyens pour détecter les changements d'état comprennent des lecteurs de code à barres (LM). 55
 16. Système selon l'une quelconque des revendications 1 à 15, caractérisé en ce que les moyens centraux de traitement (MSERV) sont adaptés et configurés pour synchroniser périodiquement tous les dispositifs de mesure du temps inclus sur la chaîne.
 17. Procédé pour enregistrer des données concernant les conditions de production d'un article produit sur une chaîne de production comprenant une pluralité de postes de travail (S1, S2, S3, S4, S5, MAN, TEST), caractérisé en ce qu'il comprend les étapes suivantes:
 - associer à chaque article une marque portant un code d'identification qui peut être détecté par des instruments à l'entrée (IN) de la chaîne,
 - détecter et enregistrer dans des moyens de mémoire (HD), quand l'article est entré dans et/ou sorti d'un des postes de la chaîne, le code associé à l'article, une donnée indiquant l'étape de fabrication effectuée à ce poste, et une donnée indiquant l'heure à laquelle le code est détecté,
 - détecter et enregistrer dans les moyens de mémoire (HD), au moins pour certaines postes de la chaîne, des changements d'état au niveau des conditions de fonctionnement du poste et une donnée indiquant l'heure à laquelle le changement d'état ou de condition de fonctionnement du poste s'est produit.
 18. Procédé selon la revendication 17, caractérisé en ce que l'étape consistant à associer une marque à chaque article comprend les étapes consistant à produire une étiquette portant le code d'identification et à appliquer l'étiquette sur l'article.
 19. Procédé selon la revendication 17 ou la revendication 18, caractérisé en ce que le code est imprimé sur l'étiquette sous la forme d'un code à barres.
 20. Procédé selon l'une quelconque des revendications 17 à 19, caractérisé en ce que le code d'identification est différent pour chaque article passant sur la chaîne.
 21. Procédé selon la revendication 19 ou la revendication 20, caractérisé en ce que l'étape consistant à détecter et enregistrer le code a lieu pour tous les postes de travail de la chaîne.
 22. Procédé selon la revendication 21, caractérisé en ce que la donnée indiquant le moment où le code est détecté comprend une donnée indiquant la date et une donnée indiquant l'heure à laquelle la détection a lieu.
 23. Procédé selon la revendication 21 ou la revendica-

tion 22, caractérisé en ce que la donnée indiquant l'étape de fabrication effectuée comprend une donnée indiquant le poste de travail où l'étape de fabrication a été effectuée.

24. Procédé selon la revendication 23, caractérisé en ce que la donnée indiquant l'étape de fabrication effectuée comprend une donnée indiquant les opérations spécifiques effectuées pendant l'étape de fabrication.

25. Procédé selon la revendication 23 ou la revendication 24, dans lequel les étapes de fabrication comprennent des étapes de test, caractérisé en ce que la donnée indiquant l'étape de fabrication effectuée comprend une donnée indiquant le résultat de l'étape de fabrication.

26. Procédé selon la revendication 25, caractérisé en ce que l'étape consistant à détecter et enregistrer les changements d'état a lieu pour tous les postes de travail de la chaîne.

27. Procédé selon la revendication 26, caractérisé en ce que la donnée indiquant le moment où les changements d'état se produisent comprend une donnée indiquant la date et une donnée indiquant l'heure à laquelle les changements d'état se sont produits.

28. Procédé selon la revendication 26 ou la revendication 27, caractérisé en ce que l'étape consistant à détecter et enregistrer les changements d'état a lieu pour des changements d'état sélectionnés dans le groupe constitué par:

- les changements dans le lot de composants et/ou de matériaux utilisés sur les postes de travail,
- les changements dans les programmes de commande des postes de travail,
- les changements dans les paramètres de fonctionnement des postes de travail,
- les changements dans les programmes de test des postes de travail,
- les changements dans les outils utilisés sur les postes de travail,
- les changements dans les conditions d'environnement concernant les postes de travail,
- les changements dans le personnel employé aux postes de travail.

29. Procédé selon la revendication 28, caractérisé en ce que l'étape consistant à détecter et enregistrer les changements d'état a lieu pour tous les changements d'état.

30. Procédé selon l'une quelconque des revendications

17 à 29, caractérisé en ce que les codes sont détectés au moyen de lecteurs de code à barres automatiques (LA).

5 31. Procédé selon l'une quelconque des revendications 17 à 30, caractérisé en ce que certains des changements d'état sont détectés par la lecture de codes à barres.

10 32. Procédé selon l'une quelconque des revendications 17 à 31, dans lequel la chaîne comprend un système de traitement et de communication (MSERV, LSERV, NET), caractérisé en ce qu'il comprend l'étape consistant à communiquer la détection des codes et des changements d'état au moyen du système de communication (NET).

15 33. Procédé selon l'une quelconque des revendications 17 à 32, caractérisé en ce qu'il comprend l'étape consistant à synchroniser périodiquement tous les dispositifs de mesure du temps inclus sur la chaîne.

25

30

35

40

45

50

55

